The research integrity expert

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Having positive and preferably spectacular research findings is wonderful. It helps you to get a publication in a journal with a high impact factor, which will be cited often and may attract a lot of media attention. This is not only a pleasant ego boost but may also be instrumental in getting your next grant or strengthening your academic position. So, in an ever more competitive and metrics-driven scientific environment, it is tempting to make such results occur by any means necessary. And while downright fabrication or falsification of data is probably rare, the more subtle forms of sloppy science are not.

One common tactic is to conduct a number of statistical analyses and publish only the one that you like most. If you torture your data enough, they will always confess. Giving a strong positive spin to your results by selective citation of earlier publications may also do the trick. Arguably the largest evil in the "sloppy science" category is to simply ignore negative results – either by publishing no paper at all, or, more subtly, by cherry-picking and reporting only positive findings. Either way, the absence of negative results severely distorts the accumulated body of evidence in the scientific literature and means that most of the published positive results are likely to be false positives.

This was explained as long ago as 2005 by John Ioannidis in his landmark *Plos Medicine* article "Why most research findings are false". More recently, it has been shown that only between 10 and 40 per cent of published findings are reproducible: most recently by a large-scale attempt to replicate major findings in psychology, published last year in *Science*. This is the price we pay for selective reporting. The reproducibility crisis, as the phenomenon is called, implies an enormous waste of resources. But it can also lead to ethical issues when animal studies or clinical research are based on false positives in earlier work.

It is not easy to find out how large the unpublished body of evidence is, and the extent to which it differs from the published record. The only real solution is full prospective transparency. Only by making available study protocols, lab journals, data analysis plans and all study results will it be possible to identify and adjust for the magnitude of distortion due to selective reporting. These principles were implemented more than a decade ago for clinical trials, but are still largely non-existent in other research traditions.

Another major countermeasure to sloppy science would be to foster a research culture that promotes open discussion of dilemmas, constructive criticism and internal audits. Good supervision and inspirational role models should guide young scientists to strengthen their moral compass and resist the temptation to cut corners.

Action is already being taken, but more is needed. Academic leaders should diversify evaluation criteria, and make clear that science is not only about being cited as much as possible. Funders should demand full transparency and refuse to pay if scientists do not comply. And journals should make sure that manuscripts are judged for the relevance of the research question and the soundness of the methods, but not on the findings they report. Furthermore, editors should demand the publication of full datasets and encourage post-publication peer review.

Doing all that would require more resources per project, entailing that fewer could be conducted. But that is exactly what we need: slow, sound, transparent science. Less, carried out in this way, would undoubtedly be more.

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